

WHAT IS CLAIMED IS:

1. A haptic mouse interface system which provides force and tactile feedbacks to a user's hand and fingers to allow the user to feel a virtual object displayed on a computer screen, the haptic mouse interface system comprising:

a mouse;

a first force feedback unit including:

first and second encoders to receive signals respectively corresponding to a mechanical property in a first direction of the virtual object;

first and second motors driven by the first and second encoders and having shafts, respectively; and

a linkage, which is operationally connected at a ground joint thereof to shafts of the first and second motors and connected at another joint to the mouse to provide a first force feedback to the user's hand and arm;

a second force feedback unit provided in the mouse, including:

a third encoder to receive a signal corresponding to the mechanical property in second and third directions perpendicular to the first direction of the virtual object;

a third motor driven by the third encoder and having a shaft; and

a pair of finger pads provided at both sides of the mouse and linearly moved by the third motor to provide a second force feedback to the user's fingers; and a tactile feedback unit provided in the mouse, including:

5 at least one actuator attached to the mouse; and
a plurality of pins coupled to the actuator to come into contact with the user's fingers, wherein the actuator receives signals corresponding to surface properties of the virtual object, and drives the plurality of pins
10 according to the received signals, thereby providing pressure or vibration exhibiting the surface properties of the virtual object to the user's fingers.

2. The haptic mouse interface system as set forth in claim
15 1, wherein the second force feedback unit further includes a pair of cables, which are connected to the pair of finger pads, respectively, and wound around the shaft of the third motor, so as to transform a rotational movement of the third motor into linear movements of the pair of finger pads.

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3. The haptic mouse interface system as set forth in claim 2, wherein each of the pair of finger pads includes a pin head to be in contact with the user's fingers and having a slit, and a pin rod extended from the pin head and having a longitudinal
25 guide groove formed on an outer surface thereof, and wherein

each of the pair of cables surrounds the corresponding finger pad through the guide groove formed on the pin rod and the slit of the pin head.

5 4. The haptic mouse interface system as set forth in claim 3, wherein each of the finger pads includes a bolt tightened into a threaded hole of the pin head, and a tension bar having a hole through which the bolt passes and moves together with the bolt, whereby the tension bar is moved close to and away
10 from the pin head when the bolt is tightened and loosened.

5. The haptic mouse interface system as set forth in claim 1, wherein the linkage is comprised of four bars hingedly connected at ends portions thereof, in which two bars connected
15 to a first hinge point corresponding to the first joint of the linkage are operationally connected to the shafts of the first and second motors to be moved, respectively, and the other two bars are connected to a second hinge point corresponding to the second joint of the linkage which is positioned diagonally
20 opposite to the first hinge point and connected to the mouse.

6. The haptic mouse interface system as set forth in claim 5, further comprising a mouse plate fixed to the first force feedback unit and positioned between the linkage and the mouse
25 so as to allow a user's wrist to be placed thereon.

7. The haptic mouse interface system as set forth in claim 6, wherein the mouse plate is formed with a communicating hole through which the second hinge point of the linkage is
5 connected to the mouse, the communicating hole being formed into a sector shape having an area larger than an operating range of the second hinge point fixed to the mouse.

8. The haptic mouse interface system as set forth in claim
10 1, wherein the tactile feedback unit includes a plurality of plate-shaped actuators which can be bent upon its activation, and a holding base attached to the mouse and having a plurality of steps, the plurality of plate-shaped actuators being sequentially attached to the corresponding steps of the holding
15 base, respectively, and being provided at its free end with the plurality of pins.

9. The haptic mouse interface system as set forth in claim 8, wherein the actuators of the tactile feedback unit are
20 bimorph type bendable piezoelectric actuator.

10. The haptic mouse interface system as set forth in claim 1, wherein the pins coupled to the actuator are arranged such that free ends of the pins are positioned at the same
25 plane.